FINAL

NASAPLANNED DEVELOPMENT PROGRAM

FOR

MICROSPACECRAFT PRODUCT ASSURANCE

Tom E. Gindorf

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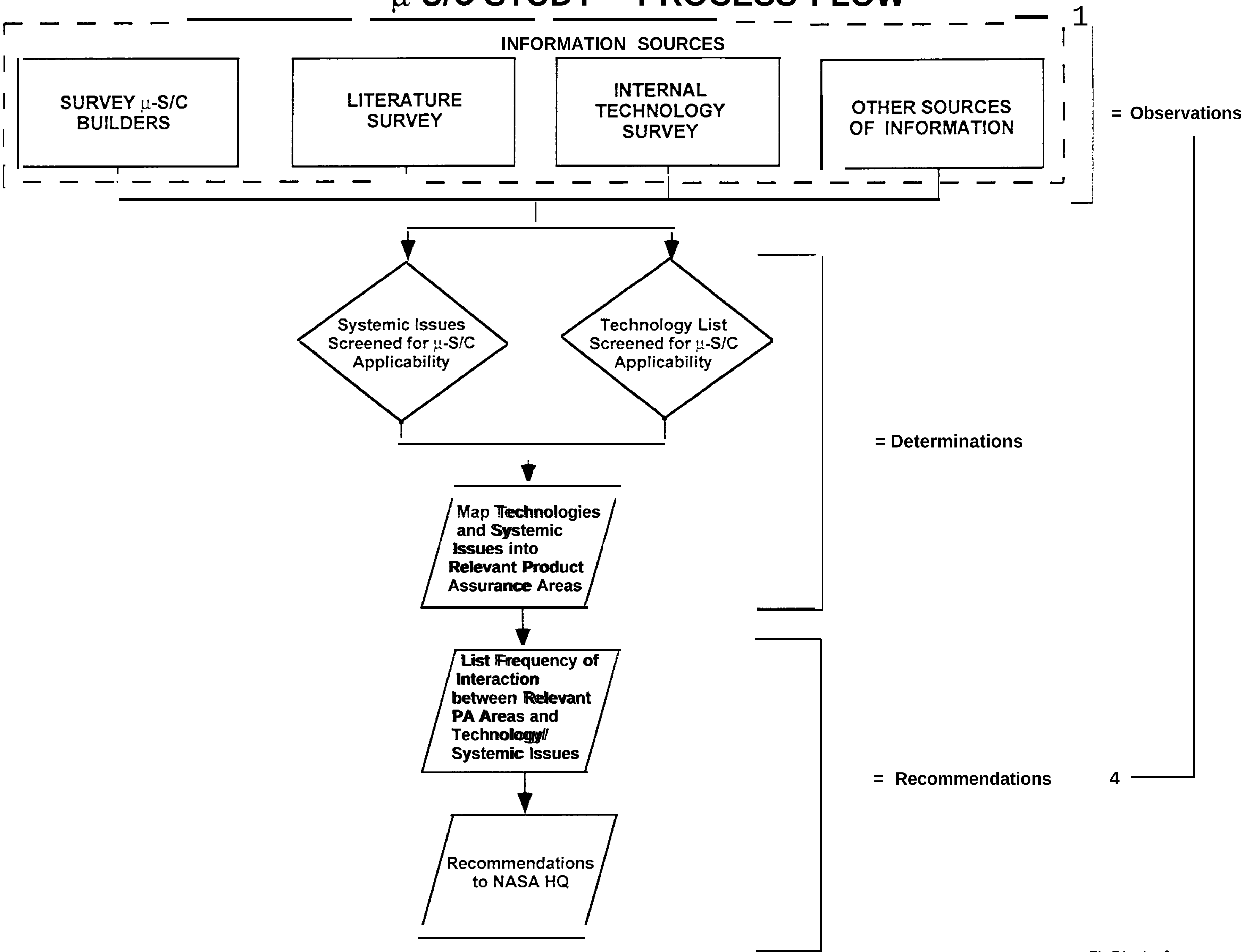
MICROSPACECRAFT STUDY EFFORT

Why

- Determine existing state of microspacecraft development and status of mission assurance activity
- Identify mission assurance activities which enable acceleration of new technologies or improve schedule/cost
- Identify mission assurance roadblocks which retard progress and remove them or develop improvements

μ-S/C STUDY -- PROCESS FLOW



μ-S/C STUDY DETERMINATION

- Use of new technology is accelerating rapidly
- Product assurance technology assessments/implication should be periodically performed (-2 year centers)
- Technology insertion plan needed to establish degree of preflight assurance validation
- Known good die screening program for high reliability application needed
- Radiation data on commercial and advanced microelectronics needed
- Qualified MMICs and their packaging for telecommunications application is needed
- Manufacturing process critical parameter identification and control need development
- Applications for single build S/C with commercial off-the-shelf hardware needs to be understood
- u-S/C unique QA methodologies need to be identified and developed
- Advanced packaging concepts need development to optimize mass to volume ratio for μ-S/C

μ-S/C STUDY DETERMINATION (cont.)

- **Special light weight materials qualification approaches need clarification**
- **Approach systematic design assessment for off-the-shelf hardware is needed**
- **New redundancy strategies for high reliability applications are needed for** p-sic
- **New standards of reliability practice need to be established**
- **Long term storage efforts on μ-S/C hardware need to be understood**
- **Thermal reliability is altered by power and radiating area for μ-S/C. Implications need definition.**
- **Radiated emissions and susceptibility of μ-S/C are affected by new densities and geometry. Implications need definition.**
- **Environmental testing needs refocus to p-S/C issues and logistics**
- **Improved defect detection and prevention methods needed**

RECOMMENDATIONS

Product Element	Deliverable
• μ-S/C **Requirements/Reduction** Thrust	• μ-S/C Product Assurance Guidelines • Report on process of reductions and conclusions rationale
• Risk/Requirements Trade-offs	• Guidelines containing μ-S/C risk trade-off depictions
• Defect Detection/Prevention	• ACEQ methodology for application to μ-S/C • Cost trade-off matrices
• Technology Insertion Plan/Process	• Detailed technology insertion plan identifying technical status and required actions
• Parts Radiation Data Base	• Report on radiation data, recommended design approach, hardness methods
• MMIC Advanced Telecom Technology	• MMIC qualification methodology • List of advanced MMIC devices qualified • Qualification data on qualified MMICs
• Long Life/Long Term Storage	• Guidelines for design and test to assure μ-S/C long life/storage adequacy
• Critical Parameters Ident. and Control	• Methodology for utilizing identified critical parameters in manufacturing cycle
• Guidance & Control Technology Qual.	• Qual. methodology for ring laser gyro, micro-machined gyro, interferomic gyro
• Test Bed Criteria for Minimal Building Hardware	• Reporting containing approach for implementing reliability and environmental test concurrent with test bed development activity and criteria for validation status
• Standard Interface Bus	• Reporting containing recommended standard inst./test bed interfaces
• Characterization of New Structural Materials	• List characterizing new technology and materials data for u-S/C

μ-S/C SUMMARY

. Maximum leverage off of μ-S/C study recommendations is obtained by:

  . Application of top 4 recommendations to New Millennium
  . Quick start of these tasks
  . Rapid delivery of products (cumulative)

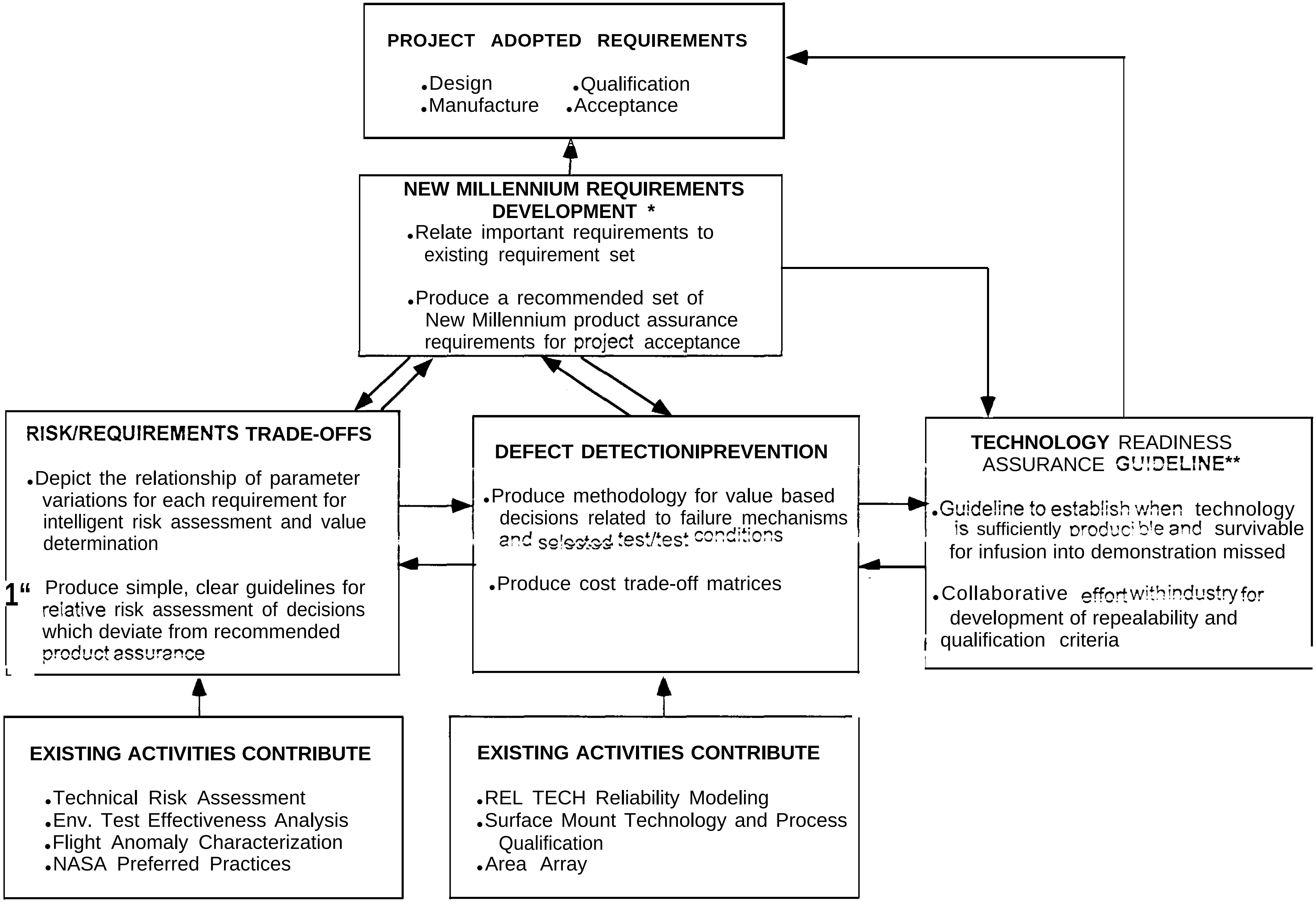
. Planned activity is collected into a Safety and Mission Assurance (Code Q) thrust for New Millennium

- NEW MILLENNIUM MISSION ASSURANCE REQUIREMENTS

  Additional Title Changes are:

Recommended Title		New Name
μ-S/C Requirements Reduction Thrust	+	New Millennium Requirements Development
Risk Requirements Tradeoffs	→	No Change
Defect Detection/Prevention	→	No Change
Technology Insertion Plan/Process	→	Technology Readiness Assurance Guideline

NEW MILLENNIUM MISSION ASSURANCE REQUIREMENT

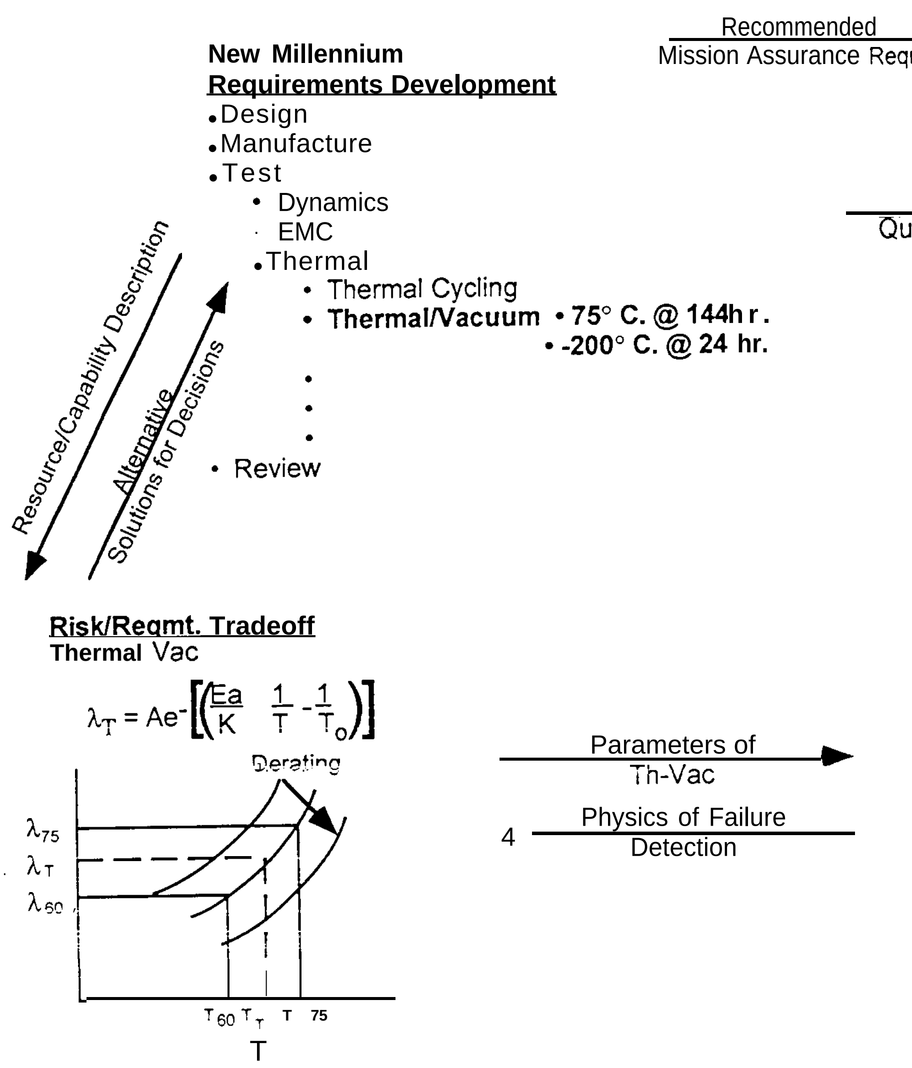


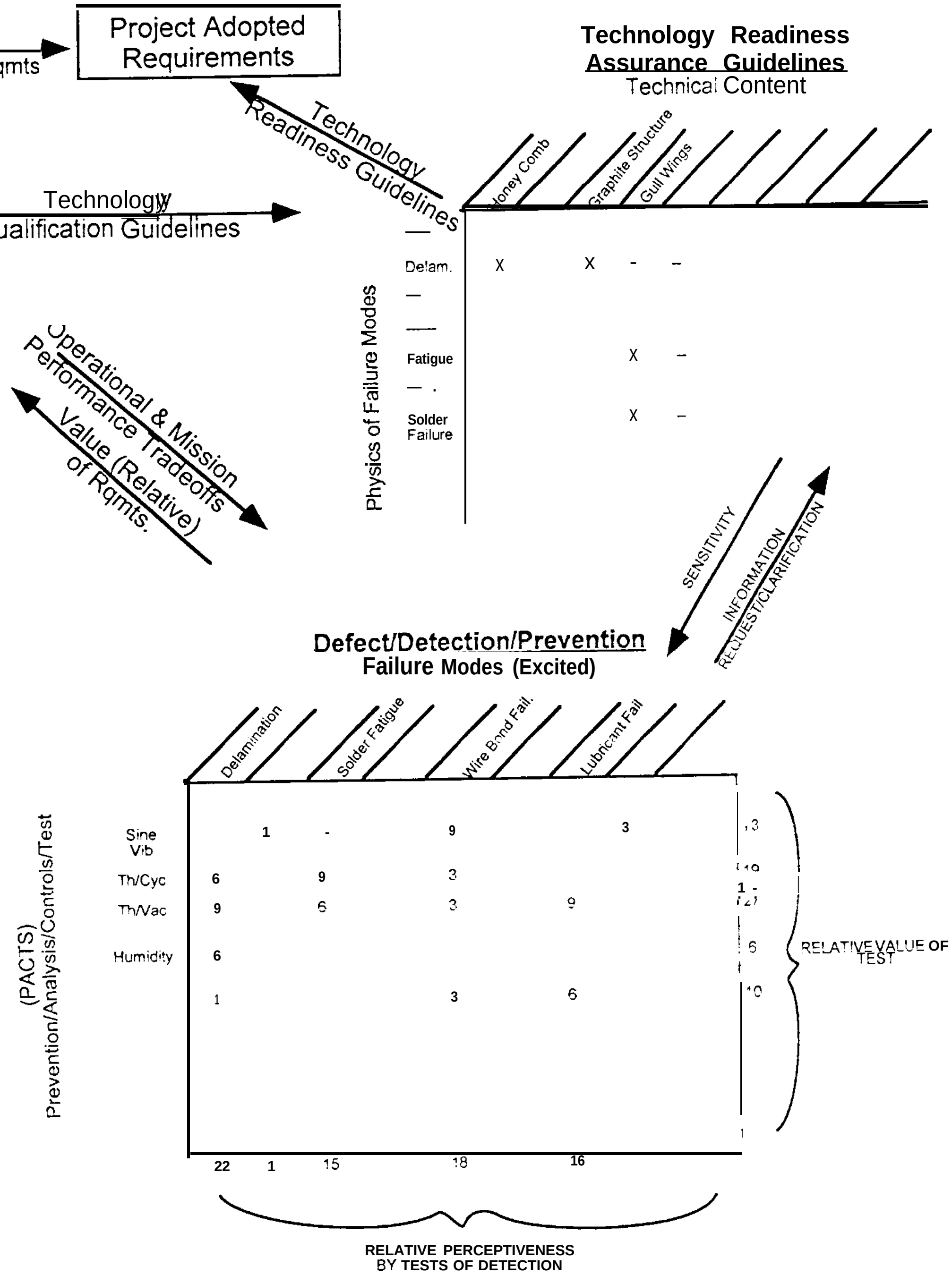
* Previously called μ-S/C Requirements Reduction, achieved through either elimination of existing requirements or project tailoring.

● *Previously called μ-S/C Technology Insertion Plan.

T. Gindorf 4-26 -95-8

EXAMPLE OF REQUIREMENTS/VALUE/TRADEOFFS





Test Temp = T_T assume 60° C.

For 60° C. to screen as 75° C. **Assume** $\left(\frac{\lambda 75}{\lambda 60} = 2\right)$

x Hrs. @ 60 deg. C. $\left(\frac{\lambda 75}{\lambda 60}\right)$ 144 Hrs. = 144 (2)= 288 Hrs. for equivalent stress f(t).

AN ALTERNATIVE CAN BE DEVELOPED.
CAVEAT: **PHYSICS OF FAILURE THRESHOLD EFFECT CAN** BE AFFECTED BY LEVEL.

SUMMARY

. New technology and new concepts require new approaches

. Cost and schedule are major considerations, but quality and reliability must be maintained

. Succinct, clear, usable technical relationships must be articulated for understanding of value and content so project managers can make informed mission assurance decisions

. Less mission assurance can be of more value when the success achieved by cost effective and prudent risk taking is greater than the cost of failure